RANGER RADIO HANDBOOK

Ryan

Ryan Aeronautical Company

San Diego 12, Calif.

OPERATING AND MAINTENANCE

HANDBOOK

MODEL 120-B RECEIVER AND MODEL 209 TRANSMITTER

"RANGER"

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NOTE: The package in which you receive your RANGER Model 120-B/209 combination receiver-transmitter should include all of the following items. The attention of your dealer should be directed immediately to any shortage.

1 - Ranger Model 120-B Receiver.
1 - Ranger Model 209 Transmitter, complete with shock mounting.
1 - 10' Shielded Cable.
4 - Mounting Screws for Model 120-B Receiver.
1 - Antenna Connector.
1 - 12 Volt Battery Connector

INSTALLATION AND MAINTENANCE INSTRUCTIONS

Ranger Model 120-B Aircraft Range and Broadcast Receiver

GENERAL SPECIFICATIONS

Dimensions: 6" wide x 5" high x 6-3/8" deep, excluding knobs.

Weight: 3 Lbs., 11 oz.

Power Requirements: (From Model 209 Transmitter) 12-14 volts at .9 amperes, 210 volts at 45 milli-amperes, at maximum volume.

Frequency Coverage: 195 to 410 KC and 540 to 1550 KC.

Average Sensitivity: 2 microvolts for 1 watt output.

Signal to Noise Ratio: 20 to 1 at 10 Microvolts.

Average Selectivity: 2 times down at 4 KC.

Average Maximum Audio Output: 3 watts to 3.2 ohm speaker; 250 mw. to headphones.

Average Image Rejection Ratio: 1000 to 1 on range band, 300 to 1 on broadcast band.

Minimum I.F. Rejection Ratio: 600 to 1.

Range Filter: 30 times down at 1020 cycles per second.

Intermediate Frequency 150 KC.

TUBES AND FUNCTIONS

1 -- 12BA6	R.F. Amplifier
1 -- 12BE6	Converter
1 -- 12BA6	I.F. Amplifier
1 -- 6AT6	Second Detector, AVC, and first audio amplifier
2 -- 6AK6	Output audio amplifier

CIRCUIT DESCRIPTION
(Refer to Circuit Diagram on Last Page)

The RANGER Model 120-B Aircraft Receiver is a high-performance 6 tube superheterodyne designed for the reception of radio range stations, airport control towers, and other radio services utilizing the 195 to 410 KC frequency band. The standard broadcast band is also provided. The receiver also serves as a remote control unit for the RANGER Model 209 Aircraft Transmitter. An eight-conductor interconnecting cable supplies filament, plate, microphone, on/off relay, send/receive relay, and coaxial low impedance antenna connections. The low intermediate frequency of 150 KC provides high selectivity and high sensitivity. A stage of tuned radio frequency amplification provides high image rejection. Limited automatic volume control is employed to prevent reversal of the A-N range signals. Any increase in signal strength between the range of 1 microvolt and 100,000 microvolts will produce

an increase in receiver audio output. The characteristic audio output impedance is 3.2 ohms, for use with a standard permanent magnet dynamic speaker with a voice coil impedance to match. 1 or 2 pairs of low impedance phones may be used. The range filter is of the series tuned type and is inserted in the plate circuit of the first audio amplifier. Resistor R11 is used in series with the assembly on the broadcast band to improve the audio response on this band only.

PROVISION FOR LOW IMPEDANCE LOOP

Connection for low impedance loop is provided by a quick "disconnect" 1" long at rear of set.

INSTALLATION INSTRUCTIONS

The RANGER Model 120-B Receiver is designed for mounting in the glove compartment or other cut-out in the instrument panel and due care should be exercised that it is so placed as to be conveniently accessible to the pilot. The microphone and headphone jacks should be mounted to the left of the pilot through 3/8" holes placed so that the cords cannot interfere with controls.

The interconnecting cable should be solidly grounded to the air frame at several points and should be adequately tied or taped to prevent chafing. No separate receiving antenna is required since the antenna switch over relay in the Model 209 Transmitter permits the use of the transmitting antenna for this purpose. The 3" wire (#228) at rear is for 3.2 ohm speaker. The 9" wire (#229) is for the receiver dial light.

MAINTENANCE INSTRUCTIONS

If the receiver fails to perform normally, (1) test the tubes and replace any that are defective; (2) measure socket voltages and compare with those listed in the table below. A voltage deviation of more than 10% from listed values will probably indicate the source of trouble. All measurements should be made with 20,000 ohms per volt meter on 250 volt scale. Volume control should be turned to maximum.

VOLTAGE TABLE

		Heater	Plate	Screen	Cathode
12BA6	R.F. Amplifier	13	135	52	2
12BE6	Converter	13	209	52	0
12BA6	I.F. Amplifier	13	209	52	0
6AT6	Second Detector, AVC, First Audio Amplifier	6.5	90	--	0
6AK6 (2)	Output Audio Amplifier	6.5	196	210	12

ALIGNMENT PROCEDURE

The receiver has been carefully aligned at the factory and realignment should not be attempted unless faulty performance is indicated and until steps (1) and (2) above have been completed. In the event that realignment is deemed necessary, the standard superheterodyne alignment procedure may be employed.

For I.F. alignment the signal generator must be tuned to 150 KC. No dummy antenna is used. The connection from the generator should be made directly to pin 1 (ground) and 7 (antenna) of P 1. Place the band switch in the range position and tune the receiver to 200 KC. The I.F. Transformer may now be aligned by turning the screws on the top of L4 and L5 (refer to chassis diagram). IMPORTANT NOTE: All adjustments should be made with an output meter which may be an AC volt meter connected across the voice coil terminals. Alignment should be performed at a very low signal level to prevent the automatic volume control from acting (volume control near maximum position). The broadcast band should be aligned next, as the broadcast alignment has a reaction on the range band alignment. Place the band switch in the broadcast position, tune the receiver to 550 KC, set the signal generator at 550 KC. Align with the top slugs on L1, L2 and L3. Set the dial at 1550 KC, tune the generator to 1550 KC. Adjust 3 trimmers on top of variable condenser. Repeat the foregoing two operations several times because these adjustments are interlocking. When completed, the accuracy of dial readings should be within 2%. For range band alignment proceed as follows: Tune the signal generator to 200 KC, set the band switch in the range position, tune the receiver to 200 KC, turn the receiver upside down. Alignment is then performed by the bottom adjustments of L1, L2 and L3. Tune the receiver to 400 KC, set the signal generator at 400 KC. Adjust the trimmers in the left chassis wall. Repeat these foregoing two operations several times as these adjustments are also interlocking.

RANGER MODEL 209 AIRCRAFT TRANSMITTER

GENERAL SPECIFICATIONS

Dimensions: 7½" wide, 7" high, 9" deep. Width over shock mounts: 9"
Weight of Transmitter: 13 lbs., 2 oz., including shock mount and connectors.
Weight of Connecting Cable: 14 oz.
Standard Frequency: 3105 KC
Power Output: 15 to 18 watts (on standard frequency).
Current Drain at 14 Volts: Stand-by condition, with Model 120-B Receiver in Operation: 5 amperes.
Transmitter in Operation, unmodulated: 8.9 amperes.
Transmitter in Operation, 100% modulated: 9.5 amperes.

TUBES AND FUNCTIONS

1 -- 12A6	Oscillator	1 -- 12SL7GT	Speech Amplifier - Phase inverter.
1 -- 807	Power Amplifier		
2 -- 6V6GT	Modulators	1 -- 12J5GT	Sidetone Amplifier
2 -- 6X5GT	Rectifiers		

FCC LICENSING INFORMATION

It is necessary to obtain a station license from FCC for the operation of an aircraft transmitter. It is necessary that FCC Form 404 (revised May 31, 1944), Application for Aircraft Radio Station License, be filed with them. The data listed below refers to certain questions contained in the above form and relates to the Model 209 Transmitter:

Frequency: 3105 KC Operating Power: 15 Watts

Points of Communication: Ground Emission: A3

Complete technical details concerning the RANGER Model 209 Transmitter have been filed with FCC. However, it is recommended that you fill out the questions relating to these details in order to save time in the issuance of your license:

Tube Complement:	Number & Type of Tubes	Normal Plate Current Per Tube	Voltage
Oscillator.	1 -- 12A6	15 MA	250
Intermediate	None	None	None
Final	1 -- 807	80 MA	300
Modulator	2 -- 6V6GT	35 MA	300

Oscillator Circuit: Pierce Crystal

Plate Power Supply for last radio stage: Double vibrator.
Rating: Current 180 MA Voltage 300.

Type or Class of modulation: AB

Radio stage to be modulated: Final

Maximum percentage of modulation: 100%

What percentage of the assigned frequency is this transmitter designed or guaranteed by the manufacturer to hold the operating frequency - .01%

CIRCUIT DESCRIPTION

The Model 209 Transmitter is designed for use in aircraft equipped with a 12 volt storage battery and generator. It is designed for use with the Model 120-B Receiver, which provides the remote control functions. Thus, the pilot has control of an entire two-way radio system through a standard 3" instrument opening. The circuit includes a crystal oscillator which furnishes more than adequate excitation to the power amplifier tube. The modulator is capable of modulating the final amplifier 100%. The high mu 12SL7GT phase inverter and speech amplifier tube has sufficient gain to drive the modulator tubes to full output without resorting to the use of a microphone transformer. Microphone current is furnished by the modulator cathode circuit. A 12J5GT tube is connected as a cathode follower and functions as a sidetone amplifier. Its grid is connected to the output of the speech amplifier, and its cathode circuit furnishes approximately 2 milliwatts

of audio frequency energy to the phone jack of the Model 120-B Receiver, when using a 600 ohm head set. An antenna change-over relay is provided beneath the chassis making practical the use of a single antenna for both transmitter and receiver. Impedance matching between the antenna and receiver input circuit is obtained by means of an impedance matching inductance located beneath the chassis.

The power supply is of the vibrator type employing a vibrator which has double contacts on each side of the vibrating reed. Incorporated in the rear compartment in the vibrator supply is a hash filter which reduces the vibrator hash to a level equal to, or lower than, the inherent noise level of the Model 120-B Receiver. Also located in this compartment is a primary relay which is operated by the on-off switch mounted on the volume control of the Model 120-B Receiver. This relay applies voltage to the vibrator power supply and to the filaments of the tubes in the transmitter and receiver, thereby placing the receiver in operation and the transmitter in stand-by condition.

INSTALLATION INSTRUCTIONS

The Model 209 Transmitter is designed to be remotely controlled by means of the Model 120-B Receiver. Since the transmitter requires no adjustment during flight, it may be installed in any convenient location, without regard to accessibility to the pilot.

The output circuit is designed to operate into a 1/4 wave length antenna at 3105 KC. The theoretical length of such an antenna is 38 feet. The physical length of this antenna will be shortened somewhat by the following factors:

1. The amount of wire between the antenna loading tap in use and ground.

2. The lead-in length.

3. The effective antenna height.

4. Additional capacity of any part of the antenna system to ground. (See installation drawing.)

It is necessary to determine the exact length of the antenna for the particular airplane in which the installation is being made. The easiest and quickest method for establishing this length is as follows:

A trial antenna should be made with a number of insulators inserted in the antenna at intervals of 1 foot, using a thermo-couple ammeter as an indicator. (See antenna diagram.) These insulators should be shorted out progressively (reloading and retuning transmitter as each insulator is shorted out) until maximum antenna current is obtained. This current will usually be between .6 and 1.2 amperes, with 14 volts input. When the exact antenna length has been thus determined, a permanent antenna of equal length may be installed on the aircraft in the form of a "V". The apex of the "V" may be either to the front or

rear, with the ends of the "V" 24 inches or more apart. There is no cancellation effect through doubling back such a quarter wave length antenna because all parts are in phase. The effect of such an antenna is to induce a large current in the airframe, which does most of the radiating in this case. Such an antenna will have a nearly circular radiation pattern.

In an Ercoupe, or similar twin-rudder airplane, install an open-triangle type antenna (center-section, to fin, to fin, to center-section) connecting the lead-in to either of the forward ends. In a typical installation, with approximately two feet of lead-in, the correct antenna length will be found to be very close to 30 feet (exclusive of the lead-in length) for the recommended operating frequency of 3105 KC. All tuning is done for maximum antenna current. After each antenna loading adjustment the plate tuning control should be readjusted for maximum output. When maximum antenna current has been obtained, the dial lock is tightened and the R.F. ammeter is removed.

NOTE: Do not use an antenna ammeter with external thermo-couple for these measurements. The use of a Field Strength Meter will be helpful for final tuning adjustment. It is suggested that the service man keep notes on the optimum antenna for each type of aircraft to save time in future identical installations. Where a trailing antenna is used, an R.F. ammeter should be permanently mounted where the pilot may view it, permitting adjustment for maximum output with either 1/4 or 3/4 wave lengths of wire trailing.

Where a single wire fixed antenna of less than 1/4 wave length is used, it will be necessary to insert some loading inductance in series with the lead-in, or preferably at the far end of the antenna. This antenna has considerably less radiation than the efficient "V" type fixed antenna described above.

If operation on 6210 KC with a trailing antenna is desired, the 3105 KC crystal must be replaced with a 6210 KC crystal, the plate tuning control set at 12 and the antenna tuning control set at the tap which provides the greatest output. Tuning is then accomplished by reeling the antenna out to the length which provides maximum antenna current. Under these conditions (with 6210 KC crystal and trailing antenna) operation on 3105 KC may be provided by retuning the plate and antenna controls for second harmonic operation of the power amplifier. However, when the power amplifier is functioning as a frequency doubler, a slight reduction in efficiency results, and for this reason it is recommended that straight-through operation be employed wherever practical.

ON 6210 KC MORE SATISFACTORY RESULTS ARE OBTAINABLE BY USING THE FIXED "V" ANTENNA DESCRIBED ABOVE, AND IT IS HIGHLY RECOMMENDED THAT THE "V" ANTENNA TUNING PROCEDURE BE CAREFULLY FOLLOWED.

OPERATION OF MODEL 209 TRANSMITTER WITHOUT MODEL 120-B RECEIVER

The Model 209 Transmitter may be operated without the Model 120-B Receiver by providing proper termination of the control end of the cable. The following parts will be needed:

1 -- Toggle Switch, single pole single throw.
1 -- Jones Socket Type S-308-AB or Type S-308-CCT.
1 -- Microphone Jack.
1 -- Resistor, 5000 ohms 20 watts.

The 2 circuit microphone jack is connected to pins 1, 5 and 6 of the Jones socket for the proper connection of the microphone in use, (refer to circuit diagram). A toggle switch for turning on and off the transmitter should be connected between pins 1 and 4. The load resistor of 5000 ohms should be connected between pins 1 and 3. Operation is then effected by turning the toggle switch to the "ON" position, which places the transmitter in the stand-by position, and pressing the microphone button to transmit.

The resistor of 5000 ohms is to prevent the unloaded power supply voltage from rising to a value which would cause damage to the electrolytic condensers.

MAINTENANCE INSTRUCTIONS

The Model 209 Transmitter contains high-quality components operating well within maximum ratings, and should provide reliable trouble-free operation without periodic inspection or maintenance. In the event of a failure, the following procedure should be used:

1. Inspect fuse (one 10 amp 3AG fuse is used; accessible from front of transmitter cabinet), replace if necessary.

2. Test tubes, replace if defective.

3. Check microphone, plug and jack.

4. Inspect and check operation of on-off relay and send-receive relay.

5. Check vibrator.

6. In the event that steps 1 through 5 do not reveal the cause of failure, check tube voltages and currents against those listed below. A deviation of more than 10% from listed values will probably indicate the source of trouble.

The following table is made for primary input at the designed center of 14 volts. These voltages may be plus or minus 10%. All voltages measured to chassis with 1000 ohm per volt meter.

TABLE OF VOLTAGE - CURRENT

Tube		Plate Volts	Screen Volts	Cathode Volts	Plate MA	Grid MA
12A6	Oscillator	240	155	0	14	----
807	Amplifier	325	252	0	80*	4
12SL7GT	Speech Amplifier and Phase Inverter	115	---	1.8	.6	----
		121	---	1.8	.5	----
6V6GT	Modulators (Both)	328	331	25	66**	----
12J5GT	Sidetone Amplifier	240	---	8.3	3.3	----
6X5GT	Rectifier (Both)	---	---	460***	---	----

Input Battery Voltage: 14 volts.

* Loaded value. Unloaded 807 plate current drops to 6 MA.
** Total cathode current. At 100% modulation current rises to 78 MA.
*** While receiving. (331 while transmitting.)

REPLACEMENT PARTS

All replaceable parts for the RANGER Model 120-B Receiver and Model 209 Transmitter are listed on page 9. These parts may be secured either from your radio dealer, or directly from the Ryan Aeronautical Company. In general, resistor tolerances are 10% and condenser tolerances 20%. It is essential when ordering replacement parts that the following information be furnished:

1. Receiver and/or Transmitter model number
2. Receiver and/or Transmitter serial number
3. Circuit part number.
4. Name of dealer from which you purchased equipment.
5. Date of purchase.

RANGER MODEL 209 TRANSMITTER REPLACEMENT PARTS

Part numbers correspond to those on circuit diagram.

RESISTORS

R1	100,000	ohm	1/3	Watt 10%
R2	47,000	ohm	1	Watt 10%
R3	47,000	ohm	1	Watt 10%
R4	10,000	ohm	1	Watt 10%
R5	200	ohm	1/3	Watt 10%
R6	220,000	ohm	1/3	Watt 10%
R7	2,200	ohm	1/3	Watt 10%
R8	220,000	ohm	1/3	Watt 10%
R9	220,000	ohm	1/3	Watt 10%
R10	220,000	ohm	1/3	Watt 10%
R11	220,000	ohm	1/3	Watt 10%
R12	10,000	ohm	1/3	Watt 10%
R13	270	ohm	2	Watt 10%
R14	100	ohm	1	Watt 10%
R15	2,200	ohm	1/3	Watt 10%
R16	5,000	ohm	10	Watt 10%
R17	5,000	ohm	10	Watt 10%

CONDENSERS

C1	100 mmfd	mica	400 volt
C2	.01 mfd	paper	400 volt
C3	250 mmfd	mica	400 volt
C4	250 mmfd	mica	400 volt
C5	.002 mfd	mica	600 volt
C6	140 mmfd	variable	
C7	.01 mfd	paper	400 volt
C8	.01 mfd	paper	400 volt
C9	.01 mfd	paper	400 volt
C10	20 mfd	electrolytic	25 volt*
C11	10 mfd	electrolytic	450 volt*
C12	10 mfd	electrolytic	450 volt*
C13	20 mfd	electrolytic	450 volt
C14	.005 mfd	tubular	2000 volt
C15	50 mfd	electrolytic	25 volt
C16	50 mfd	electrolytic	25 volt

L1	2.5 mh R.F. Choke
L2	2.5 mh R.F. Choke
L3	Plate coil #1944 (Std for 3105 KC)
L4	Receiver loading coil #209 L4
T1	Modulation Transformer #13502
T2	Power Transformer #2167
X	Crystal Type A-100 (6210 KC Standard)
V	Vibrator Type G-546-C
RY1	Relay Type 1601-A
RY2	Relay Type 1604
P1	Jones plug Type P-101
P2	Jones plug Type S-308-AB
P3	Jones plug Type P-202-AB
F	Fuse Type 3AG 10 Ampere

* C10, C11, and C12 are all in one can.

MODEL 120-B RECEIVER REPLACEMENT PARTS LIST

Part numbers correspond with part numbers on circuit diagram.

R1	1 megohm 1/3 watt
R2	1K ohm 1/3 watt
R3	200K ohm 1/3 watt
R4	50 K ohm 1 watt
R5	25K ohm 1/3 watt
R6	2 megohm 1/3 watt
R7	500K ohm 1/3 watt
R8	100K ohm 1/3 watt
R9	500K ohm 1/3 watt
R10	2 megohm 1/3 watt
R11	100K ohm 1/3 watt
R12	250K ohm 1/3 watt
R13	500K ohm 1/3 watt
R14	350 ohm 1 watt
R15	5K ohm 1 watt
R16	100K ohm 1 watt
R17	100K ohm Volume Control with DPST Switch
R18	25K ohm 1 watt
C1-2-3	3 Gang Variable 365 mmf per Section
C4-5-6	5 Plate Trimmers
C7	250 mmfd mica 10%
C8	250 mmfd mica 10%
C9	100 mmfd mica 10%
C10	500 mmfd mica 5%
C11	.001 mfd mica 5%
C12	.01 mfd paper 10%
C13	500 mmfd mica 10%
C14	.001 mfd mica 10%
C15	.01 mfd mica 10%
C16	250 mmfd mica 10%
C17	.03 mfd mica 10%
C18	.01 mfd paper 10%
C19	10 mfd 50 volt electrolytic
C20	.05 mfd paper 10%
C21	.05 mfd paper 10%
C22	.002 mfd mica 10%
C23	.05 mfd paper 10%
C24	.05 mfd paper 10%
L1	Antenna coils 120-1
L2	R.F. coils 120-2
L3	Oscillator coils 120-3
L4	Input I.F. Transformer 120-4
L5	Output I.F. Transformer 120-5
L6	Range Filter choke
L7	Phantom Loop Inductance
T1	Output Transformer P-89401
P1	Jones S308CCT
P2	Jones P304AB
SW1-2	Part of volume control
SW3	DPDT Slide Switch

When ordering replacement parts, please furnish model number and serial number of receiver, circuit part number, and name of RANGER Dealer from whom purchased.

STANDARD WARRANTY

(Adopted by the Radio Manufacturers Association)

We warrant each new radio product installed by us to be free from defective material and workmanship and agree to remedy any such defect or to furnish a new part in exchange for any part of any unit of our equipment which under normal installation, use and service discloses such defect, provided the unit is delivered by the owner to us or to our authorized distributor or dealer from whom purchased, intact, for our examination, with all transportation charges prepaid to our factory, within ninety days from the date of sale to original purchaser and provided that such examination discloses in our judgment that it is thus defective.

This warranty does not extend to any of our radio equipment which has been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extend to units which have been repaired or altered outside of our factory, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own installation.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by our authorized distributors or dealers without charge to the owner.

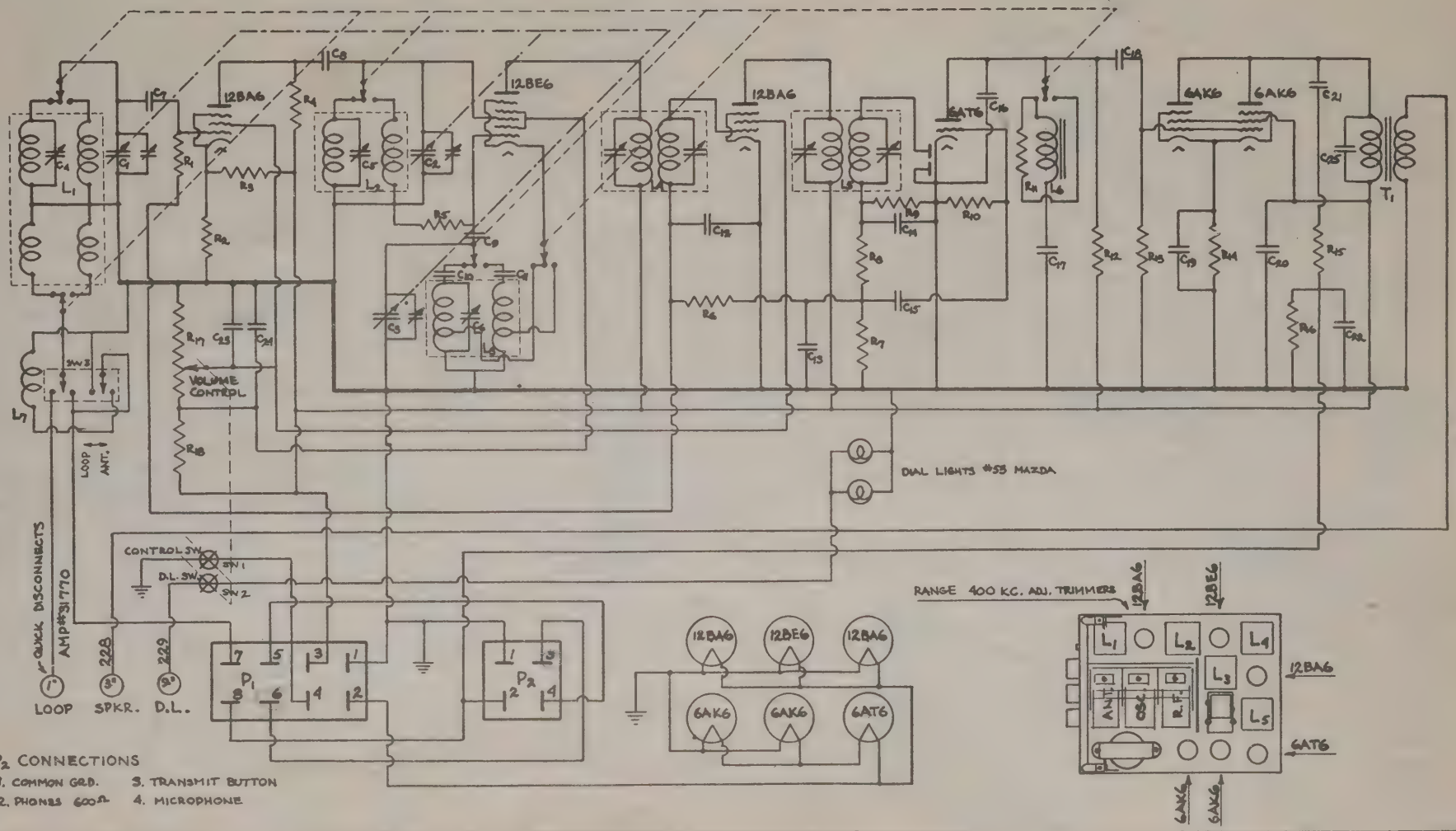
This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio equipment.

RYAN AERONAUTICAL COMPANY

Lindbergh Field
San Diego 12, California

THE RANGERS MODEL 120-B RANGE & BROADCAST RECEIVER

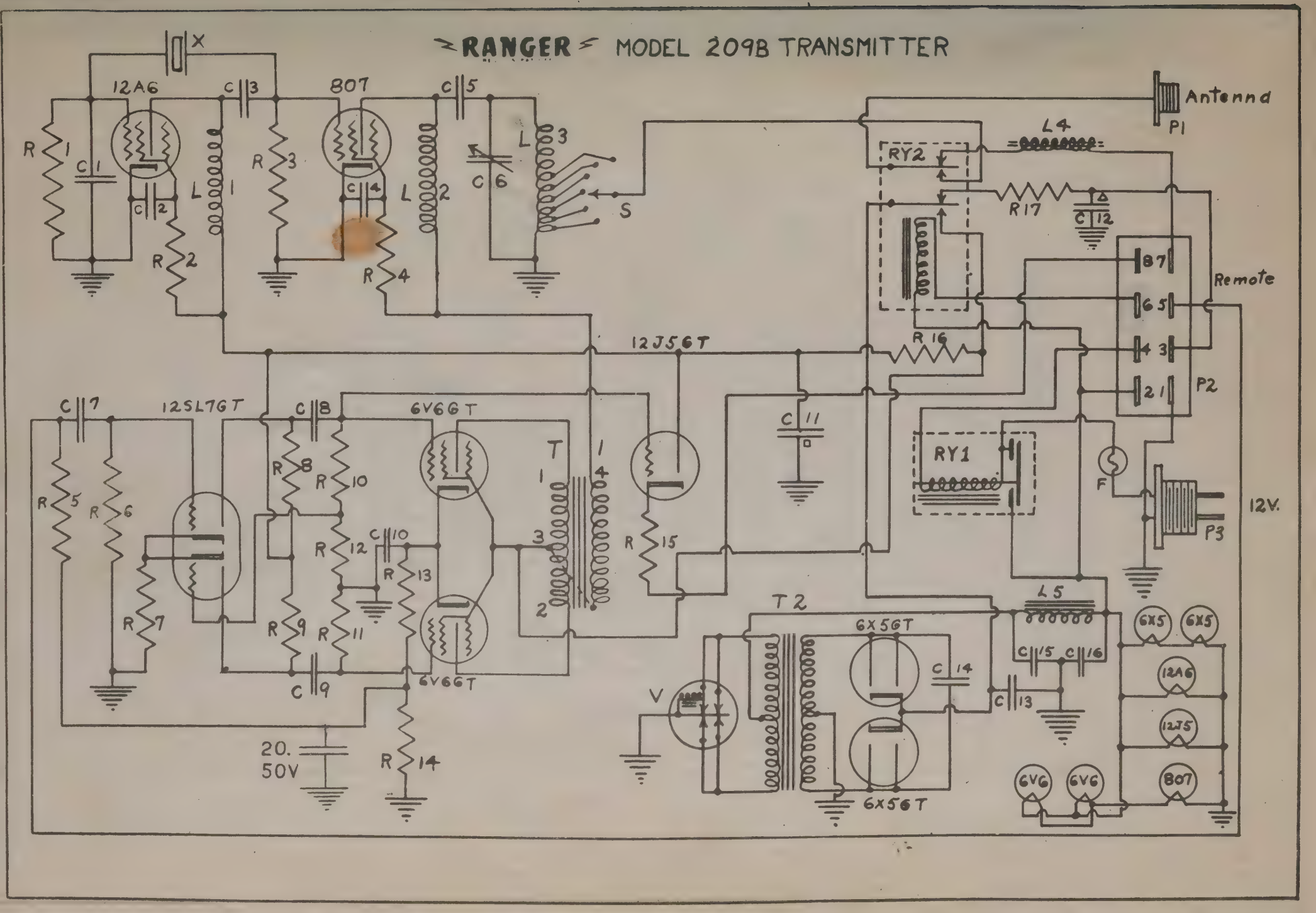
REG U.S PAT OFF.

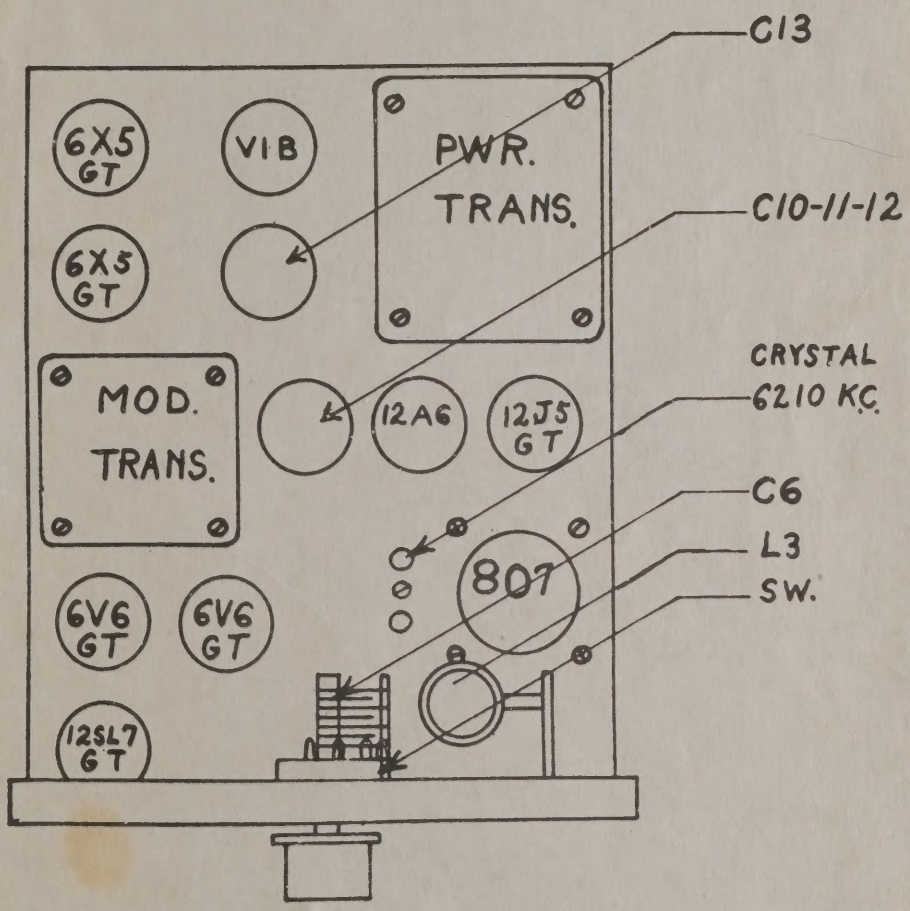
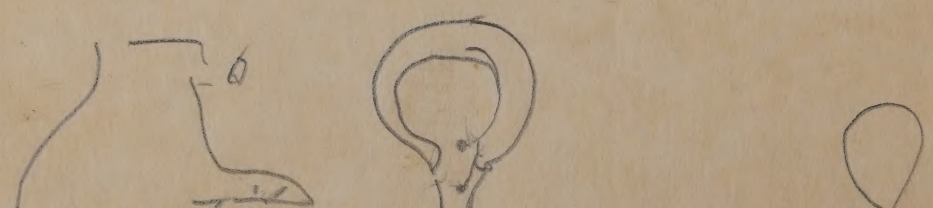


P2 CONNECTIONS

1. COMMON GRD.
2. PHONES 600Ω
3. TRANSMIT BUTTON
4. MICROPHONE

RANGER MODEL 209B TRANSMITTER



MODEL 209 TRANSMITTER

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